

eg. 6c): Calculate the forces on the rope and on the rod.

$$\alpha = 24^\circ, \beta = 45^\circ, k = 790 \text{ N}$$

$$\sum F_x = 0: -T \cos \alpha - S \cos \beta = 0 \Rightarrow S = -T \frac{\cos \alpha}{\cos \beta} \quad (1)$$

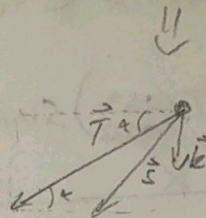
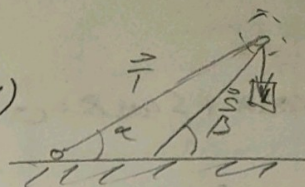
$$\sum F_y = 0: -T \sin \alpha - S \sin \beta - k = 0$$

$$-T \sin \alpha + T \frac{\cos \alpha \sin \beta}{\cos \beta} = k$$

$$T = \frac{k}{\frac{\cos \alpha \sin \beta}{\cos \beta} - \sin \alpha} = \frac{790}{\frac{\cos 24^\circ \cdot \sin 45^\circ}{\cos 45^\circ} - \sin 24^\circ}$$

$$T = 155.9 \text{ N} \quad (1)$$

$$S = 201.4 \text{ N}$$



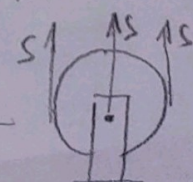
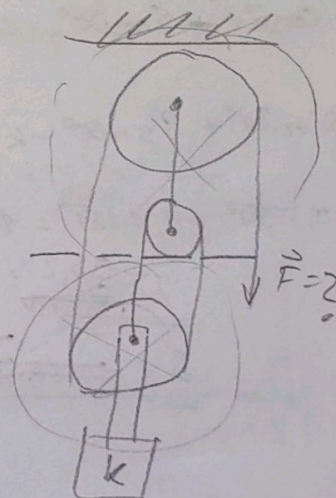
38a) What is the needed force. $k = 600 \text{ N}$

→ To raise we need to calculate this area

$$\sum F_y: 3S = k \Rightarrow S = \frac{k}{3}$$

$$\sum F_x = 0 \quad S = 200 \text{ N}$$

We need to pull with a force greater than 200 N.



eg. 5b: Calculate the rope forces. $k=350\text{N}$; $\alpha=50^\circ$; $\beta=32^\circ$

$$\sum F_x = 0: -T \cos \alpha + S \cos \beta = 0 \Rightarrow S = T \frac{\cos \alpha}{\cos \beta}$$

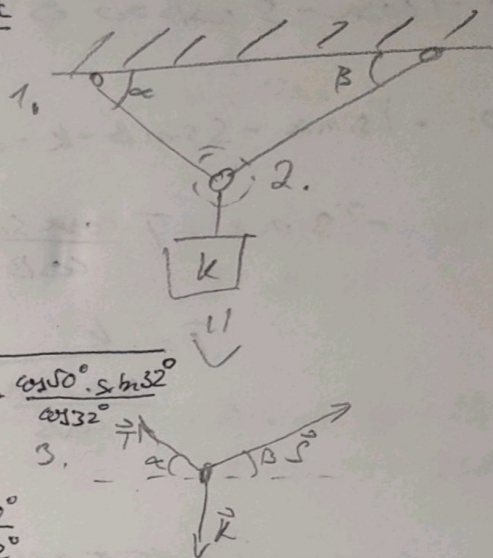
$$\sum F_y = 0: T \sin \alpha + S \sin \beta - k = 0$$

$$T \sin \alpha + \left(T \frac{\cos \alpha}{\cos \beta} \right) \sin \beta = k$$

$$T = \frac{k}{\sin \alpha + \frac{\cos \alpha \cdot \sin \beta}{\cos \beta}} = \frac{350}{\sin 50^\circ + \frac{\cos 50^\circ \cdot \sin 32^\circ}{\cos 32^\circ}}$$

$$\underline{T = 300\text{N}} \Rightarrow S = 300 \frac{\cos 50^\circ}{\cos 32^\circ}$$

$$\underline{S = 227,2\text{N}} \quad \{$$



eg. 6: Calculate the forces on the rope and the rod. $\alpha=69^\circ$; $k=140\text{N}$; $\beta=40^\circ$

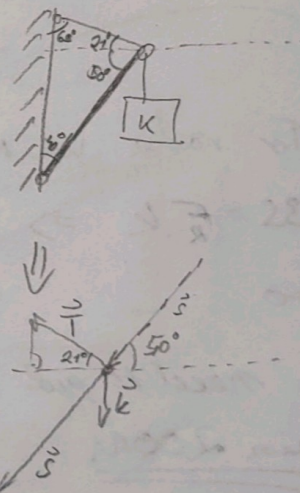
$$\sum F_x = 0: -T \cos 21^\circ - S \cos 50^\circ = 0 \Rightarrow S = -T \frac{\cos 21^\circ}{\cos 50^\circ}$$

$$\sum F_y = 0: T \sin 21^\circ - S \sin 50^\circ - k = 0$$

$$\Rightarrow 0,358T + 1,113T = 140$$

$$T = \frac{140}{1,471} = 95,2\text{N}$$

$$S = -138,2\text{N}$$



eg 9a) : What is the force F so that the system is in balance. $k = 250 \text{ N}$, $\alpha = 20^\circ$

$$\sum F_x = 0: kx + Fx' = 0$$

$$kx = k \sin \alpha$$

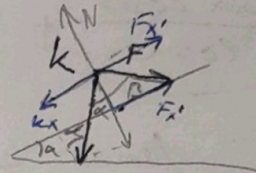
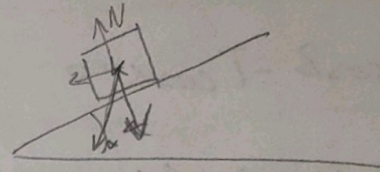
$$kx = Fx'$$

$$Fx' = F \sin \beta$$

$$\frac{k \sin \alpha}{\sin \beta} = F$$

$$\frac{250 \cdot \sin 20^\circ}{\sin 70^\circ} = F$$

$$F = 91 \text{ N}$$



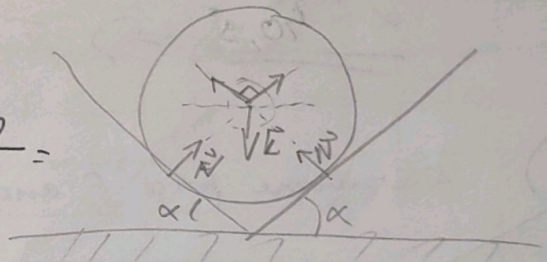
$$\beta = 90^\circ - \alpha = 70^\circ$$

eg 10a) Define the forces on the wire. $k = 15 \text{ kN}$, $\alpha = 45^\circ$

$$\sum F_y = 0: 2N \sin \alpha - k = 0$$

$$N = \frac{k}{2 \sin 45^\circ} = \frac{15000}{2 \frac{\sqrt{2}}{2}} =$$

$$N = 10600 \text{ N}$$



eg. 14) Determine force F and inner forces in the rope.
 $k = 15 \text{ kN}$

$$T = S = C$$

in the rope all the forces are the same one.

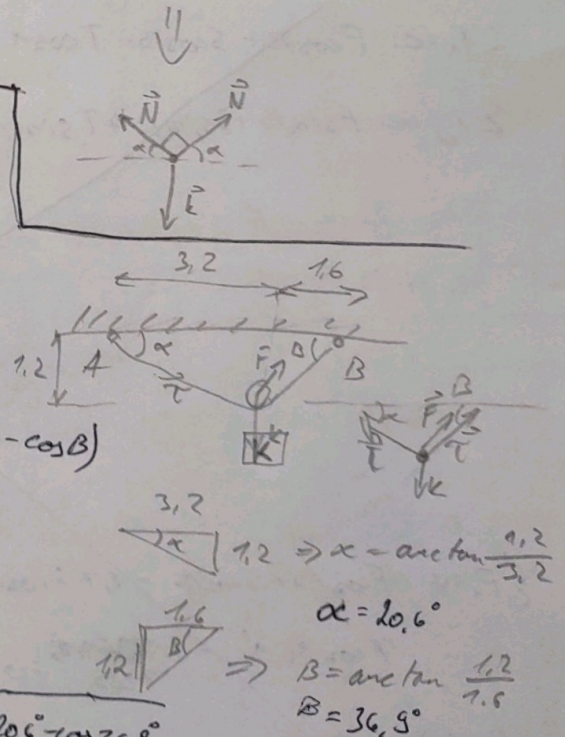
$$\sum F_x = 0: -T \cos \alpha + T \cos \beta + F = 0 \Rightarrow F = T(\cos \alpha - \cos \beta)$$

$$\sum F_y = 0: T \sin \alpha + T \sin \beta + F = k$$

$$T(\sin \alpha + \sin \beta + \cos \alpha - \cos \beta) = k$$

$$T = \frac{k}{(\dots)} = \frac{1500}{\sin 20.6^\circ + \sin 36.8^\circ + \cos 20.6^\circ - \cos 36.8^\circ}$$

$$T = 1378 \text{ N} \Rightarrow F = 188 \text{ N}$$



eg. 12) Calculate the inner force in rope T (AC), S (BC) = 5 kN, k = 6 kN, B = 40° and angle α = ?

$$\sum F_x = 0: S \cos B - T \cos \alpha = 0 \Rightarrow T = \frac{S \cos B}{\cos \alpha}$$

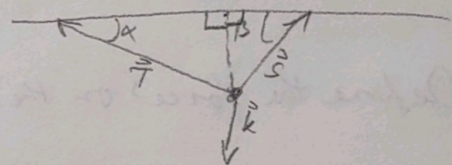
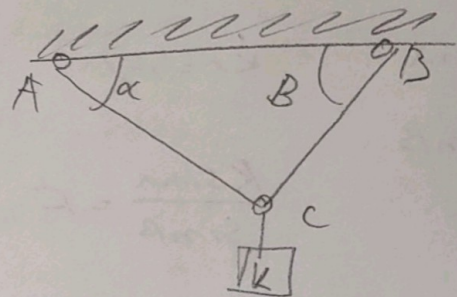
$$\sum F_y = 0: T \sin \alpha + S \sin B - k = 0$$

$$\frac{\overset{\tan \alpha}{S \sin \alpha \cos B}}{\cos \alpha} + S \sin B - k = 0$$

$$\tan \alpha = \frac{k - S \sin B}{S \cos B}$$

$$\alpha = \arctan \left(\frac{6000 - 5000 \sin 40^\circ}{5000 \cos 40^\circ} \right)$$

$$\alpha = \underline{\underline{36^\circ}} \Rightarrow T = 5000 \cdot \frac{\cos 40^\circ}{\cos 36^\circ} = \underline{\underline{4734 \text{ N}}}$$



eg. 18) What can be the maximum weight? Inner forces (T, S) can stand 1500N.

$$\sum F_x = 0: S \cos \beta - T \cos \alpha = 0 \Rightarrow T = S \frac{\cos \beta}{\cos \alpha}$$

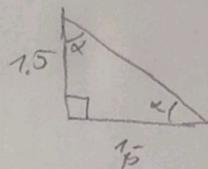
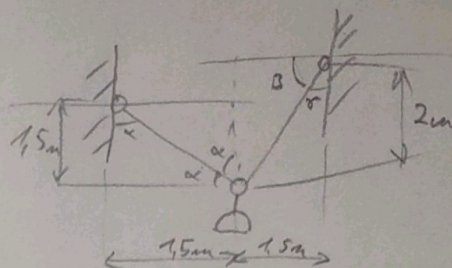
let S be 1500N

$$\sum F_y = 0: T \sin \alpha + S \sin \beta = k \Rightarrow T = 1273N$$

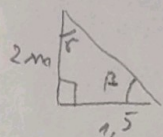
$$S \frac{\cos \beta \sin \alpha}{\cos \alpha} + S \sin \beta = k$$

$$k = 1500 \cdot \left(\frac{\cos 53.1^\circ \cdot \sin 45^\circ}{\cos 45^\circ} + \sin 53.1^\circ \right)$$

$$k = 2100N \quad (T = 1273N, S = 1500N)$$



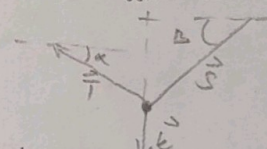
$$\Rightarrow \alpha = \arctan 1 = 45^\circ$$



$$\Rightarrow \beta = \arctan \frac{2}{1.5} = 53.1^\circ$$

$$\gamma = 90 - 53.1^\circ = 36.9^\circ$$

Some how calculate the height diff.
how to scale??



eg. 23)

Define the inner forces in the rods when $k = 1200N$

Force at this point is 4.400
 $F = 600N$

$$\sum F_x = 0: F_{PRx} + F_{QPx} = 0$$

$$F_{PR} = -\frac{12a}{12.37a} F_{PR} + \frac{4a}{5a} F_{QP} = 0 \Rightarrow F_{PR} = 0.825 F_{QP}$$

$$\sum F_y = 0: \frac{3a}{12.37a} F_{PR} + \frac{3}{5} F_{QP} - 1600 = 0$$

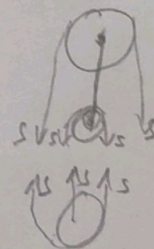
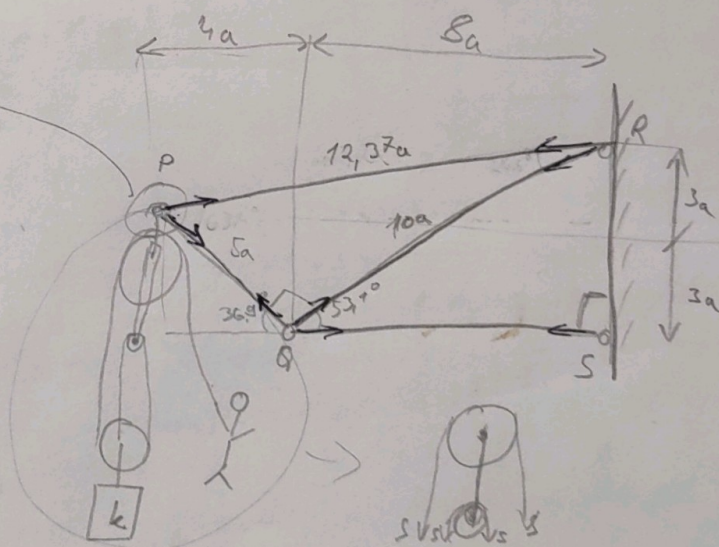
$$\downarrow$$

$$-0.2 F_{QP} - 0.6 F_{QP} - 1600 = 0 \Rightarrow F_{QP} = 2000N \Rightarrow F_{PR} = 1650N$$

$$\sum F_{Qx} = 0: F_{QSx} \cdot \frac{8}{10} + F_{QRx} \cdot \frac{6}{10} - F_{QP} \cdot \frac{4}{5} = 0$$

$$F_{QS} + \frac{4}{5} F_{QR} - 1600 = 0$$

$$+ \sum F_{Qy} = \frac{3}{5} F_{QS} + \frac{6}{10} F_{QR} = 0 \Rightarrow F_{QS} = -3200N; F_{QR} = 2000N$$



$$SS = k$$

$$S = 400N$$